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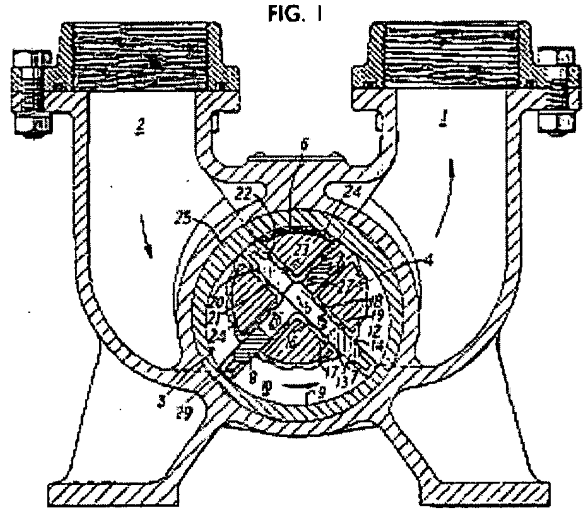
Abstract of **GB1289473**

1289473 Rotary positive-displacement machines TEGALEMIT (ENG.) Ltd 23 Sept 1969 [23 Sept 1968] 45026/68 Heading F1F To improve sealing in a pump, or motor, of the diametral-sliding-vane type the rotor 4 and the outer edges of the vanes 7, 8 are coated with an elastomer, axial grooves 16. . 19 and 24 being provided in the rotor coating to minimize friction. Alternatively, the peripheral wall of a chamber 3 for the rotor is coated with an elastomer Fig. 6 (not shown), the coatings on the circumferential surface of the rotor and on the vanes being dispensed with but the grooves 24 being retained. Ports (not shown) at the inner ends of inlet and outlet ducts 1, 2 are formed in the end walls of the chamber 3. The vane 8 may comprise two mutually-overlapping parts, Figs.2 and 4 (not shown). The profile of the peripheral wall of the chamber 3 is described in detail, Figs. 3[alpha] and 3b (not shown), and is constituted by a series of circular arcs.

FIG. 1



PATENT SPECIFICATION

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DRAWINGS ATTACHED

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1 289 473

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(54) ROTARY FLUID PUMPS AND MOTORS

(71) We, TECALEMIT (ENGINEERING) LIMITED, of Plymouth, Devon, a British Company, do hereby declare the invention, for which we pray that a patent may be granted to us and the method by which it is to be performed, to be particularly described in and by the following statement:

The present invention relates to rotary fluid pumps or motors.

More particularly the present invention is concerned with a rotary fluid pump or motor having at least two pairs of vanes which are, on rotation of the rotor, in sealing contact with a peripheral sealing wall of a chamber in which the rotor rotates. Each pair of vanes is formed by a vane member extending diametrically through the rotor so that when one vane of a pair is moved towards the rotor, the other vane is moved from the rotor by a similar amount. Inlet and outlet ducts open into the chamber and fluid is moved between the ducts by rotation of the rotor. Alternatively, the supply of fluid under pressure to the inlet duct provides a rotary output from the rotor. Such a fluid pump or motor will hereinafter be described as "of the type described".

According to the present invention there is provided a rotary fluid pump or motor of the type described in which at least some of the surfaces of the rotor which contact the vanes are made of resilient material having longitudinal grooves extending parallel to the axis of the rotor.

Preferably, the rotor is of circular section and the circumferential surface of the rotor contacts the wall of the chamber, the circumferential surface of the rotor including a longitudinal groove extending generally parallel to the axis of the rotor between two circumferentially adjacent vanes. The circumferential surface of the rotor may be made of resilient material, or alternatively, the interior surface of the chamber may be made of resilient material.

It is preferred that the inlet and outlet ducts are provided in the end walls of the chamber. Preferably, the chamber has a sealing wall contacted by the vanes, which wall has a radius of curvature with its centre on the rotor rotation axis.

However, the invention contemplates a chamber wall which has a complex sectional shape such that the distance of the walls from the circumferential surface of the rotor varies. The vane of a pair will contact a part of a wall nearer to the rotor when the other vane of the pair contacts a part of the wall farther from the rotor. The pump space then has a varying sectional area and the arrangement is such that compression is provided when the invention is used as a pump.

The chamber wall section is made up of a number of arcuate portions, each arcuate portion being of sufficient length to ensure that a vane is always in contact with it. Thus, each arcuate portion will subtend at least 90° at the centre of rotation if two vane members at right angles are used. The length of each arcuate portion can be reduced with more vane pairs.

One vane member may have a generally central aperture through which the other vane member extends. Preferably, a leak path is provided between spaces within the rotor defined by the rotor and the vane members, the leak path being restricted so as to provide a force acting against hydraulic pressure on the vanes.

An embodiment of the invention will now be described by way of example with reference to the accompanying diagrammatic drawings in which:

Figure 1 is a section across the pump;

Figure 2 shows a perspective view of the vanes;

Figures 3a and 3b show the section across the rotor chamber.

Figure 4 shows a section through the longitudinal axis of the rotor.

[Price 25p]

Figure 5 shows a perspective view of an alternative form of vanes and,

Figure 6 shows a sectional view of the chamber wall.

Referring first to Figure 1, it is seen that a main body of the pump comprises two ducts 1 and 2 which communicate with a generally cylindrical chamber 3 through ports (not shown) in the axial end walls of the chamber 3. It is to be noted that ducts 1 and 2 can be either the inlet or outlet ducts respectively depending on the direction of rotation of the rotor within the chamber. The cylindrical rotor 4 is rotatable about its central axis 5 and contacts a portion 6 of the peripheral wall of the chamber 3, hereinafter called the sealing wall 6, over part of its surface. Within the rotor are positioned two vane members 7 and 8 which extend through the centre 5 and form pairs of vanes diametrically opposite one another through the rotor 4. The vane members are slidable within the rotor so that as one extending vane is moved inwards towards the rotor, the vane member moves across the diameter to extend the other vane of the pair beyond the surface of the rotor.

The arrangement of the vanes in this particular embodiment is shown more clearly in Figures 2 and 5 and it will be appreciated that each of the vane members is movable across the diameter on which it lies independently of the other vane member. In order to construct the assembly shown in Figures 1 and 2, the vane member 8 is formed in two parts, 8A 8B to allow assembly of the components. Alternatively, the other vane member could be made in two parts but this would lead to joining one longer member along two short edges instead of one longer edge.

Rotation of the rotor causes the vanes to project downwardly (as is shown in this particular embodiment) to contact a portion 9 of the peripheral wall of the chamber between the ports, hereinafter called the pump space wall 9. As the vanes pass through the pump space 10 lying between the ports, fluid i.e. liquid is moved through this space. Thus if the rotor rotated anticlockwise, fluid would be moved through the axially disposed ports from duct 2 into duct 1. The sealing of the return path from the outlet duct to the inlet duct is achieved by having the rotor in sliding contact with the sealing wall 6 or closely spaced thereto. The edges of the vanes contacting this wall seal the return path in a positive manner and while it is preferable to have the rotor in sliding contact with the wall if a small space is left only a very small amount of fluid will be pumped in the reverse path.

One shape of the chamber section will now be discussed referring to Figure 3a. It will be noted that the radii A and B are both struck from a centre L on the rotor axis 5 and while the radii C, D, E and F are struck from other selected centres, the resulting curves GK and HJ provide sealing and pump space walls that give a smooth change of vane extension for both directions of rotation and accept a design of vane tip which induces a fluid wedge to provide film lubrication with minimum leakage. It it to be noted that Fig. 3a indicates a preferred chamber shape for two vane members arranged at right angles and therefore the arc GH subtends a right angle at centre L (which lies on the axis 5 of the rotor).

The determination of the shape of the chamber section will now be further discussed with reference to Figure 3b. It will be noted that x is selected as the radius of the rotor and therefore the arc GH has a radius also of x. The vane extension from the rotor is preferably limited to one half x hence the pump space wall indicated by the arc JK will be the arc of a circle having a radius 1.5x. If more than two vane members are used, the arcs GH and JK could be made shorter because it is required that at least one vane is contacting the walls 6 and 9 at a particular instant to ensure sealing and pumping actions. The amount of extension of each vane can be varied with necessary alteration of the radius of the arc JK. Also variation of the extension of the vanes would require alteration in the radius of the arcs GK and HJ.

These latter arcs are selected to give a smooth change of vane extension between the two circular arcs GH and JK within the chamber. The dimension quoted for the arcs GK and HJ i.e., 1.219x are appropriate when the edges of the vanes are comparatively narrow but when the thickness of the edge is a practical value these arcs become complex curves rather than arcs of circles.

As mentioned previously, the pump space wall in the pump has a sectional form which is an arc of a circle having its centre on the rotational axis of the rotor. This form gives the pump space 10 a constant radial cross-section in the fluid path along which fluid flows between the rotor and the pump space wall 9. Thus, the fluid moves through this space at a constant rate whereas in a known type of pump which has a varying cross-sectional area in the pump space the fluid is accelerated and decelerated during its journey through this space. It is probable that the fluid is subjected to this variation of velocity four times during each revolution because as a rotor rotates four volumes of fluid are moved through the pump space. These fluctuations in velocity carried through any length of delivery pipe may cause resonance and so-called water hammer.

The effect on the consistency of flow by the volume occupied by the vane in the fluid is negligible for the pump. This negligible effect occurs because the vanes are withdrawn from the fluid at a constant rate. For the present pump this means that the fluid leaves the pump at a slower constant rate of flow than when it is in the pump space.

In Figure 1 it is seen that specific steps can be taken to seal the moving parts in a preferred design and to provide bearing surfaces of low friction and good-working anti-wear characteristics. The surfaces of the working parts may be covered or partly covered by an elastomer, so that the elastomer slides on a metal surface or vice versa. Contact between such surfaces results in a very low coefficient of friction when lubricated with liquid, and the resilience of the elastomer facilitates pumping of liquids containing abrasive contaminants without undue wear of the contacting surfaces. Grooves are provided in the surface of the elastomeric covering of the rotor to improve sealing within the pump and to assist in the lubrication of the working parts.

This is now described with reference to Figure 1 and noting that the direction of rotation is anti-clockwise as shown by the arrow. The pressurised liquid 12 is in front of the protruding vane of the vane member 7, forcing the vane onto a flat surface 13, and away from a flat surface 14, thus allowing liquid to leak past the surface 14 into the cavity 15 and at the same time filling longitudinal grooves 16, 17, 18 and 19, which grooves are parallel to the axis 5, and in particular 17, where the leakage is arrested by the surface 13 thereby preventing leakage to the low pressure side of the vane. It is to be noted that this embodiment employs the vanes shown in Figure 2 or Figure 5.

Where the liquid pressure is equal on each side of the extended vane, both surfaces 13 and 14 are, due to an interference fit on the vane, active as sealing agents, i.e. in this case as on the protruding vane of vane member 8. When the vanes are in the closed condition, i.e. top end of vane member 7, then axial grooves 20, 21, 22 and 23 provide, not only seal lips, but also points of turbulence that restricts leakage and provide troughs of liquid in the grooves for lubrication of the working surfaces.

Axial grooves 24, in the periphery of the rotor, as shown in Figure 1, also provide lubrication at the sealing wall. Each groove 24 delivers a controlled amount of liquid to the suction side of the pump to provide lubrication to the working parts when the suction side fails to receive liquid, i.e. when priming.

Alternatively, the peripheral wall of the chamber 3 can be elastomer coated. The circumferential surface of the rotor and the vane tips would not then be provided with elastomer coating but the former may still be provided with axial grooves.

The elastomerising of the chamber wall can be arranged in several ways and these are as follows:

1. The elastomer can be applied to the machined wall of the chamber shown in Figure 3a and 3b.

2. A metal stator 25 in Figure 1 can be a replaceable item, and

3. The elastomerising of the chamber wall can be applied to a truly circular bore, the special chamber shape being formed by the elastomer only, as moulded. An elastomerised stator where the elastomer 28 is of even thickness is shown in Figure 6.

There is a leak path for liquid to pass from cavity 26, Figure 1 to cavity 27, to permit movement of the vane mambers. However, in this pump this leak path is restricted to provide a force that acts against the hydraulic pressure on the vanes in order to reduce wear between the vanes and the chamber wall.

In Figure 4 the vane members 7 and 8 are seen in section on the axis of rotation of rotor 4. Elastomeric surfaces 29, 30 are provided on the axial and radially outermost edges of each vane to facilitate movement of the rotor and vane members in the chamber. The rotor has axles mounted on bearings within a housing. One axle 31 is rotated by an extension 32 which is suitably keyed.

The pump can operate as a motor when supplied with fluid under pressure. Constant rate of revolutions is provided by the constant cross-section area of the space 10 which gives a constant volumetric flow.

From the Figures it is seen that the pump is of compact size and can be positioned in a simple manner between fluid supply ducts.

WHAT WE CLAIM IS:—

1. A rotary fluid pump or motor of the type described in which at least some of the surfaces of the rotor which contact the vanes are made of resilient material having longitudinal grooves extending parallel to the axis of the rotor.

2. A rotary fluid pump or motor as claimed in claim 1 in which the rotor is of circular section and in which the circumferential surface of the rotor contacts the wall of the chamber, the circumferential surface of the rotor including a longitudinal groove extending generally parallel to the axis of the rotor between each two circumferentially adjacent vanes.

3. A rotary fluid pump or motor as claimed in claim 1 or claim 2 in which the circumferential surface of the rotor is made

of resilient material.

4. A rotary fluid pump or motor as claimed in claim 1 or claim 2 in which the peripheral wall of the chamber is made of resilient material.

5. A rotary fluid pump or motor as claimed in any of the preceding claims in which the inlet and outlet ducts are provided in the end walls of the chamber.

6. A fluid pump or motor as claimed in any of the preceding claims in which the chamber has a sealing wall contacted by the vanes, which wall has a radius of curvature with its centre on the rotor rotation axis.

7. A rotary fluid pump or motor as claimed in any of the preceding claims in which one vane member has a generally central aperture through which the other vane member extends.

8. A rotary fluid pump or motor as claimed in any of the preceding claims in which a leak path is provided between spaces within the rotor defined by the rotor and the vane members, the leak path being restricted so as to provide a force acting against hydraulic pressure on the vanes.

9. A fluid pump or motor substantially as herein described with reference to the accompanying drawings.

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4 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 1

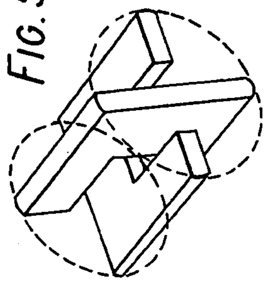


FIG. 5

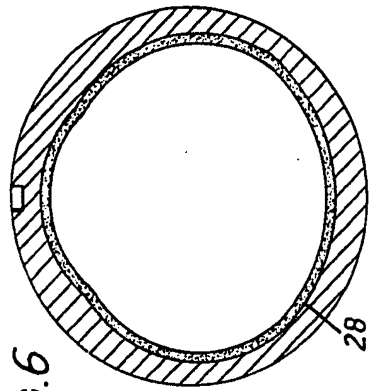


FIG. 6

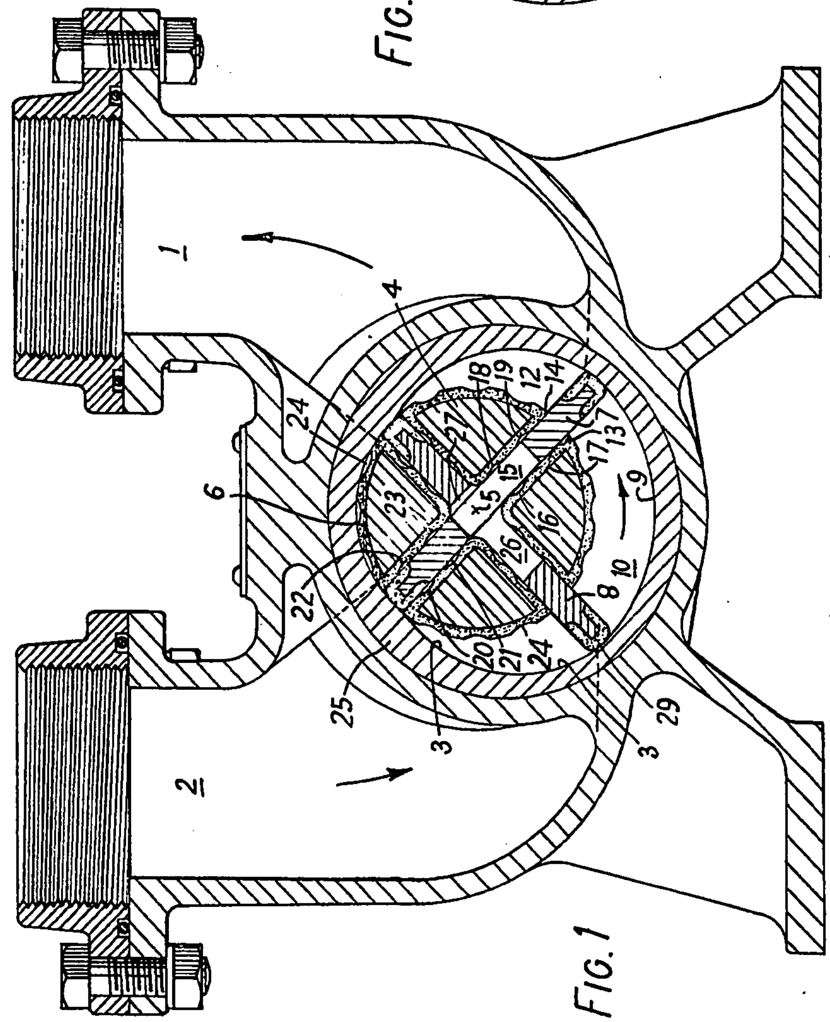


FIG. 1

FIG. 2

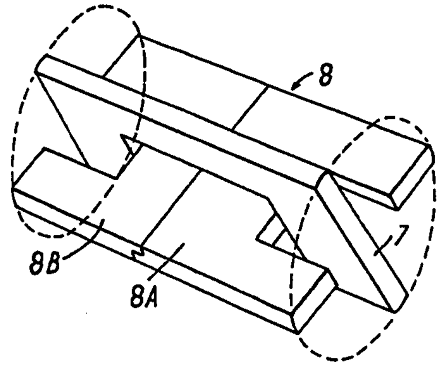


FIG. 3a

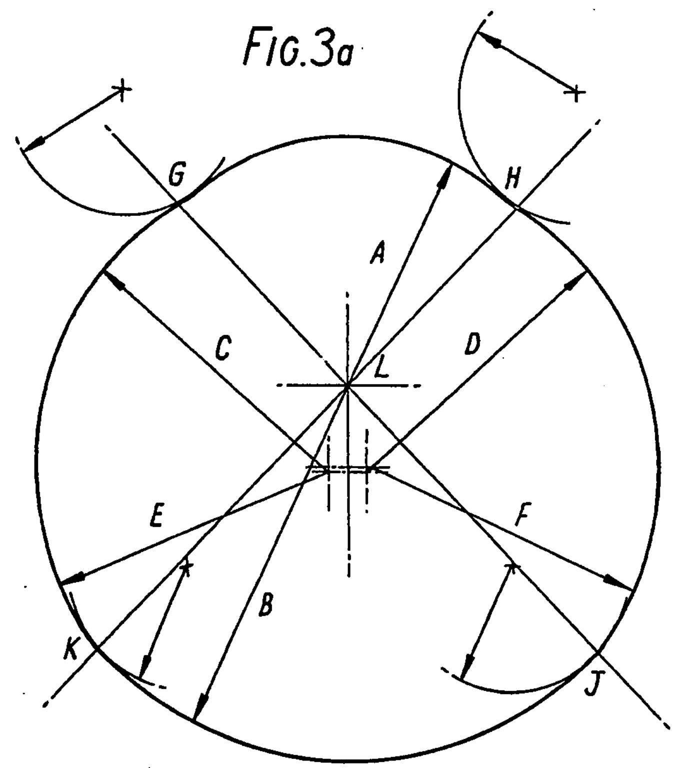
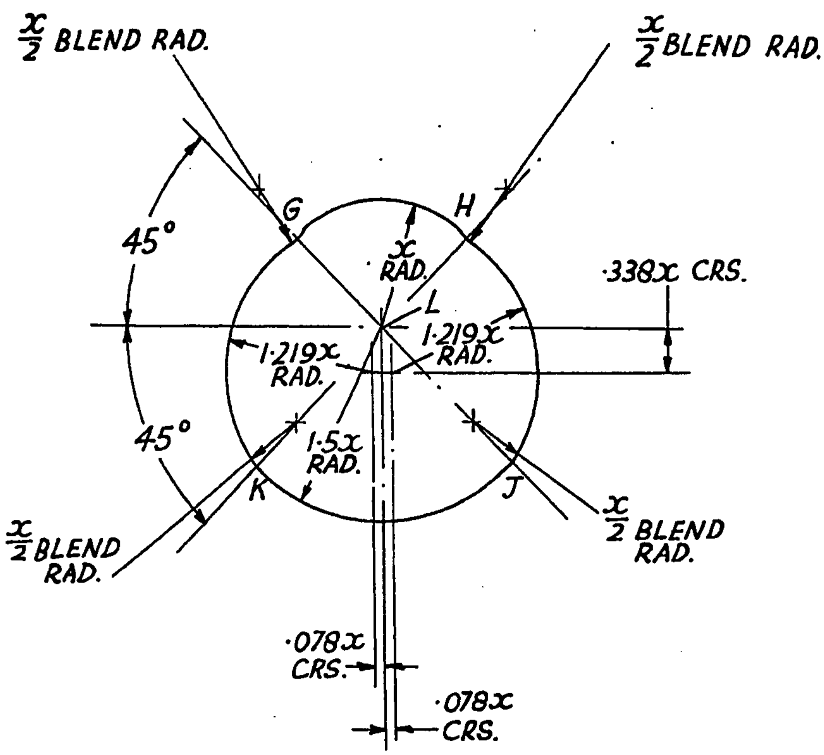


FIG. 3b.



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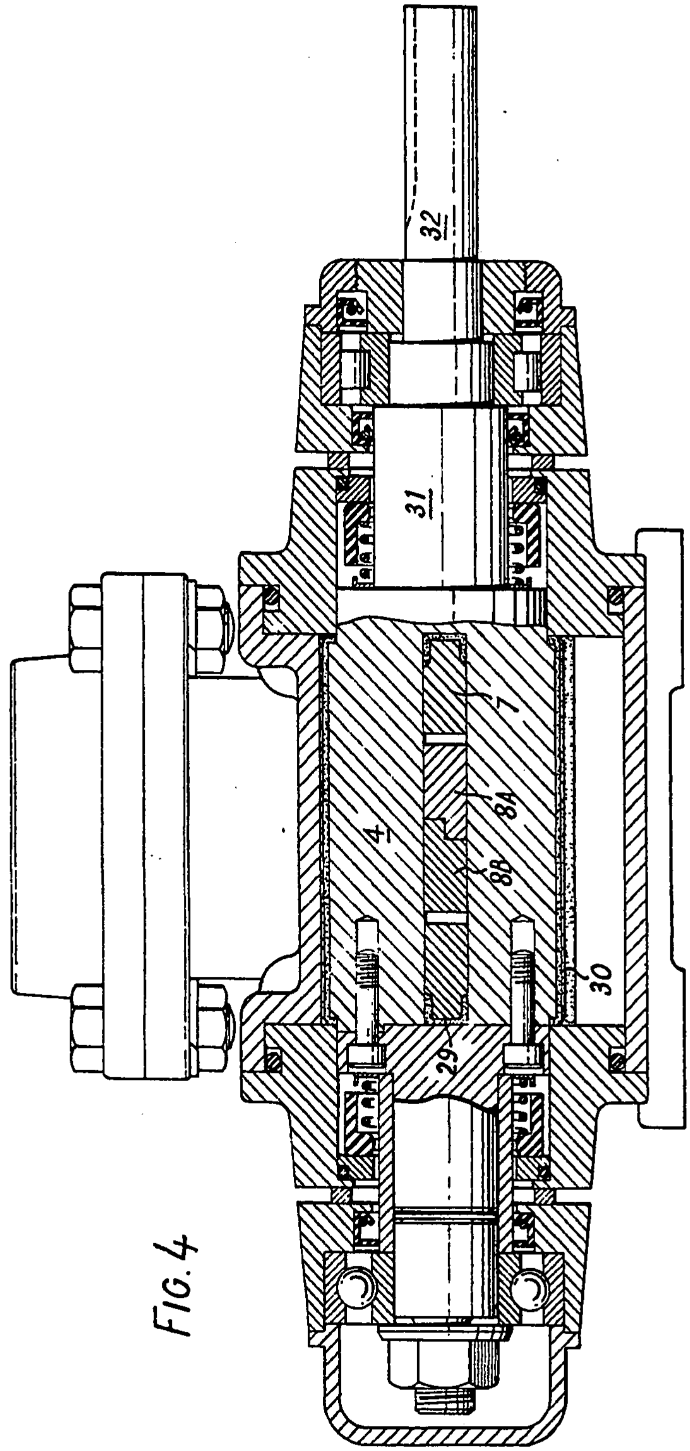

FIG. 4